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The Veterinary Record

PATRON: HER MAJESTY THE QUEEN

Vol. 70 No. 35 Issue No. 4195 693-712

August 30th, 1958

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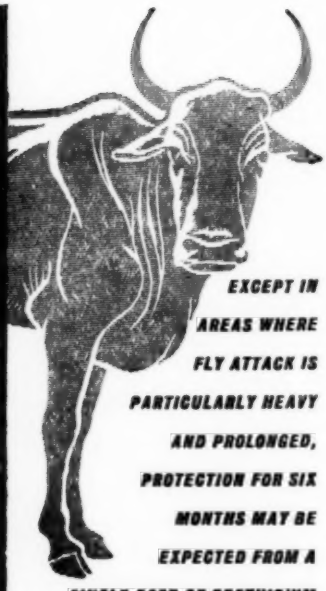

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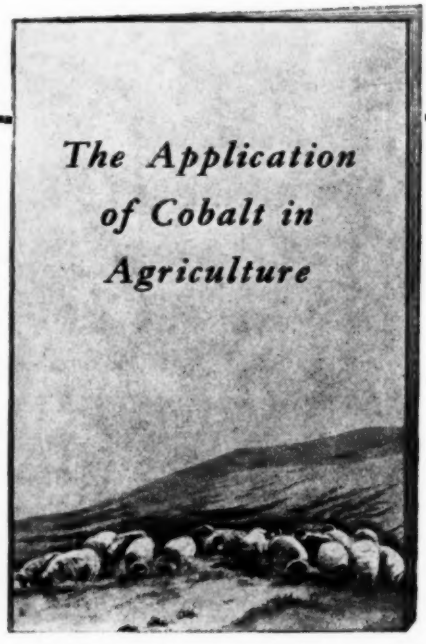

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No. 35 AUGUST 30th, 1958 Vol. 70

Registered for Transmission as a Newspaper *Price 2s. post free*

Refresher Article No. 10

The Present Knowledge of Johne's Disease

BY

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SUMMARY.—As the more spectacular diseases of cattle and sheep have been brought under control, and as the value of the individual animal has steadily increased, Johne's disease has assumed a position of greater importance in the livestock economy of this country. In this article the salient features of our factual knowledge of the disease, and the trends of thought on its possible control, are presented and discussed.

History

JOHNE'S disease, described as a chronic, infectious enteritis of cattle, sheep, and goats has certainly been in Britain for more than 100 years —probably very much more. During the 1830's an incurable form of persistent diarrhoea in cattle was frequently reported by veterinary practitioners, and from their descriptions the condition was almost certainly Johne's disease. Since none of these reports mentions its recent appearance, or refers to it in terms other than familiar, we must conclude that by that time it was already well established. It was, however, not until the beginning of this century that the infectious nature of the disease was understood.

Animals Susceptible

Although these early writings all refer to the disease in cattle we now know that sheep and goats also are susceptible, and that these three species represent the only susceptible animals of economic importance. Isolated cases have been reported in other animals, but there has always been a history of contact, or possible contact, with either cattle or sheep. For example, cases have been recorded in deer kept in parks and zoological gardens, and in a llama and a gnu, also in zoological collections. Less convincingly documented cases have been reported in the horse and the pig, but in the meantime it would be better to assume that Johne's disease is confined to the Ruminantia, although recently the causal organism has been found in the mesenteric lymph nodes of the horse without causing disease.

As strains of Johne's bacillus isolated from cattle have been used to infect sheep, and material from sheep has caused the disease when inoculated into cattle, it would appear to be possible for cattle to infect sheep and vice versa.

Distribution

Johne's disease appears to have a world-wide distribution and few countries seem to be entirely free from the disease. Prior to 1933 Iceland was free, but in that year 20 sheep from Germany were imported for breeding purposes and at least 5 of them turned out to be infected. These 5 rams set up foci of infection in the 5 areas to which they were sent, and from these areas the disease spread throughout the country. During the next 15 years between 75,000 and 100,000 sheep died of Johne's disease and the disease also spread to cattle.

It is probable that isolated areas where Johne's disease does not occur are still to be found (*e.g.* British Guiana and the Leeward Islands are reported to be free) but wherever large-scale importation of European stock has occurred the disease has been seen. The stock-breeding and exporting countries of Europe have been the main reservoirs from which the infection has continuously flowed.

Ireland is said to be free from Johne's disease but this is not strictly true as cases have frequently been reported. These cases, however, have all been in imported cattle or their progeny. Even if the disease does occur in native cattle there seems to be little doubt that its incidence is very low indeed.

In Britain the disease occurs everywhere and there is no large area of the mainland completely free. Various attempts have been made to carry out surveys but for a variety of reasons they have been disappointing. They have, however, shown that the distribution is widespread throughout the country.

Incidence

Johne's disease is not notifiable in Britain, and only a small proportion of cases is seen by veterinary surgeons in practice; no figures are therefore available which accurately depict the true disease incidence. Estimates have, however, been attempted, and the results have been expressed in a variety of ways. For example, 1 per cent. of the adult cattle population is estimated to die of clinical Johne's disease; 9 per cent. of a sample of cows received at 3 knackeries showed evidence of Johne's disease; 25 to 30 per cent. of other cattle (bulls, bullocks, heifers and yearlings) sent to the same knackeries had the disease; 28 per cent. of cattle slaughtered as casualties in an Edinburgh abattoir during 1951 and 1952 were affected; in the south of England Johne's disease affected 0.9 per cent. of a population of adult cattle and this figure represents over 20 per cent. of the losses due to disease.

Figures are also available for the non-clinical infection of adult cattle with *Mycobacterium johnei* but the significance of this type of infection is not yet understood. Numerous surveys of normal cattle passing through various abattoirs have been carried out and *M. johnei* has been recovered from 6 to 17 per cent. of the cattle sampled. It is interesting to note that the organism was not recovered from any of 100 cattle slaughtered in Ireland.

A similar slaughterhouse survey has been carried out in sheep and 21 per cent. were found to be harbouring the organism.

Economic Loss

It has already been explained that estimates of the incidence of Johne's disease in Britain are largely tentative and consequently the assessment of economic loss due to the disease must be of the same nature. For what it is worth, a figure of some £4,000,000 per annum has been reached, taking all the available information into consideration. The true figure is not likely to be less than the one given and it may well be very much more. It is based on the incidence of clinical disease in cattle alone, and takes no account of losses in sheep or those due to lowered milk yield and general unthriftiness during the prolonged incubation period. Such losses are quite incalculable but must be very considerable. When judging the relative economic importance of Johne's disease it must be remembered that whereas the salvage value of, say, an infertile cow may be high, that of a Johne's cow is almost negligible.

Mycobacterium johnei

In an article of this nature it is not necessary to dwell on the morphology and growth characteristics of *M. johnei*. It will be sufficient to recall that the slowly growing bacillus isolated from the bovine animal is the type species, and that 2 even more slowly growing strains have been isolated from sheep. One of these is pigmented yellow and seems to be found only in Scotland.

M. johnei is unique among the Mycobacteria in requiring for its growth the incorporation of other Mycobacteria, or their metabolic products, in the medium. This "accessary growth-factor" has recently been extracted from *Mycobacterium phlei* and given the name "Mycobactin."

Pathology

The alimentary canal is the main site of lesions in Johne's disease, and in advanced chronic cases these may extend from the duodenum to the rectum. In such cases, on opening the intestine the characteristic cerebrum-like corrugations of the thickened mucous membrane are exposed (Fig. 1). In less severe cases the thickening and corrugation is not so marked and the distribution of the lesions is patchy. It is, however, the author's experience that the most commonly affected area is the terminal portion of the ileum where it is about to join the caecum.

Although petechiae on the crests of the ridges forming the convolutions may give the mucous membrane a haemorrhagic appearance, haemorrhage is not a characteristic feature of the disease and the surface of the mucous membrane remains unbroken. Necrosis, caseation and calcification are never seen in cattle but may be present in the lymph nodes of both sheep and goats. In sheep the intestine may be pigmented an intense yellow but there is often very little thickening or corrugation to be seen.

The lesions are not always so easily recognised as those in Fig. 1 and sometimes comparatively mild lesions are found in quite severe cases of clinical disease. Fig. 2 shows portions of intestine from a clinical case in a 4-year-old cow and it can be observed that the intestine is comparatively thin and free from corrugations. In such a case histological examination offers the best chance of accurate diagnosis.

Histologically the intestinal lesion may vary in severity from a few groups of endothelioid cells and giant-cells to a symplasma in which the villus structure is completely lost in a confluent mass of endothelioid cells (Figs. 3 and 4). Microscopical lesions can also be seen in the lymph nodes of infected cattle. They are usually situated just below the capsule and consist of aggregates of endothelioid cells and an occasional giant-cell (Fig. 5). These lesions are similar to early tuberculous foci but, unlike them, they do not (at least in cattle) become encapsulated, necrotic, caseous or calcified. *M. johnei* can be seen associated with all these lesions.

The bacillus has also been cultivated from the uterus, cotyledons and foetus of clinically affected pregnant cattle but so far no lesions have been described in such sites.

Symptoms

The late symptoms of advanced Johne's disease need no elaboration as the picture of the rough-coated, emaciated, scouring cow is well known to us

J. DEANS RANKIN—THE PRESENT KNOWLEDGE OF JOHNE'S DISEASE

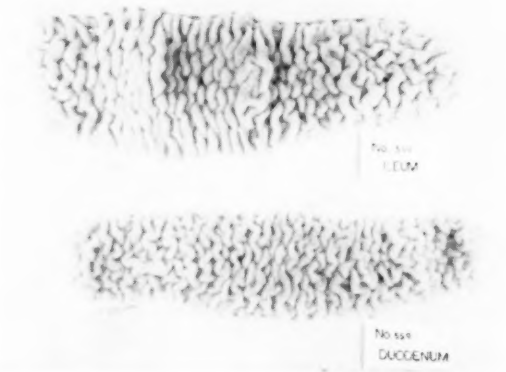

FIG. 1.—Showing portions of the small intestine from a clinical case of Johne's disease. The marked thickening of the mucous membrane and its tight brain-like convolutions are pathognomonic of Johne's disease.

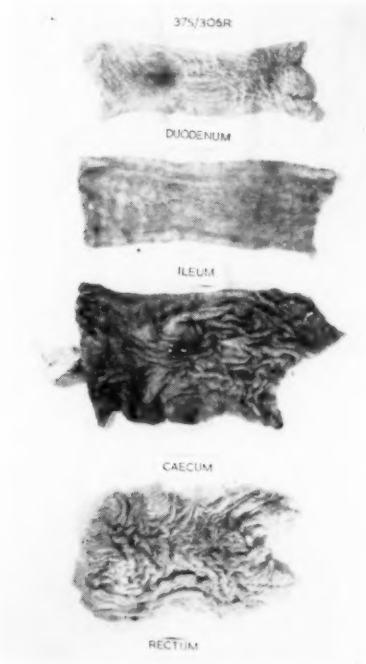

FIG. 2.—Showing portions of the intestine from a clinical case of Johne's disease. The absence of marked thickening and corrugation makes a macroscopic diagnosis impossible in this case. The corrugations in the rectum are quite normal (*c.f.* Fig. 10).

FIG. 4.—Section of ileum showing more advanced lesions of Johne's disease. Villus formation is disappearing and the mucous membrane is being replaced by a continuous mass of endothelioid cells ("symplasma"). Staining H. & E.

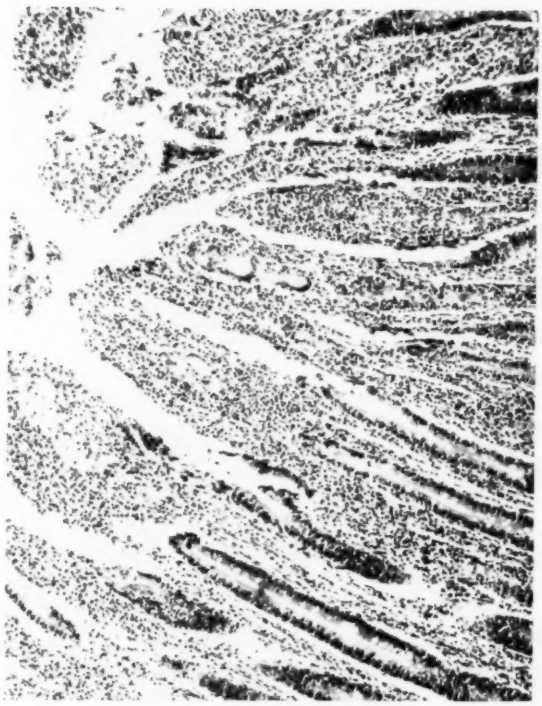

FIG. 3.—Section of ileum showing early lesions of Johne's disease. The villi are still clearly demarcated although a few groups of endothelioid and giant cells have made their appearance. Staining H. & E.

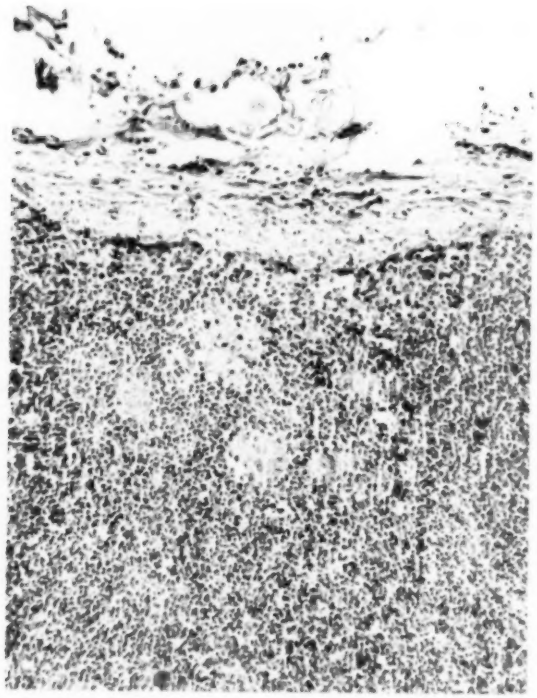

FIG. 5.—Section of a lymph node from a case of Johne's disease showing sub-capsular groups of endothelioid cells. Staining H. & E.

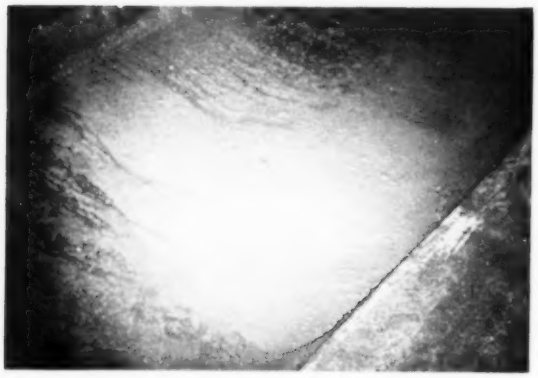

FIG. 8.—Faeces from a case of Johne's disease showing bubble formation and illustrating the consistency.

FIG. 9.—Characteristic groups of acid-fast bacilli in a smear from a case of Johne's disease. Staining Z.N.

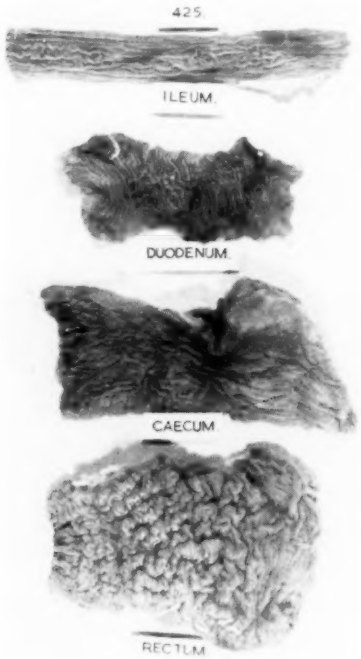

FIG. 10.—Portions of intestine from a normal cow. The corrugation and apparent thickening of the mucous membrane could lead to an erroneous diagnosis of Johne's disease.

all. An early sign, however, of approaching breakdown is the appearance of a swelling under the jaw (Fig. 6). This is by no means a constant symptom

FIG. 6.—Sub-mandibular oedema in a case of Johne's disease.

but its relationship to Johne's disease has been recognised for many years. The swelling is oedematous in nature and frequently disappears when diarrhoea begins. A sharp fall in milk yield has also been associated with pending Johne's disease and there is some indication that even in the lactation prior to the appearance of symptoms a low, or very low, yield is returned.

In sheep and goats diarrhoea is not a constant symptom but the faeces often loses its pellet formation for short periods. Loosening of the wool has frequently been reported as a symptom in sheep but this is probably not specific. The only constant symptom in all animals is progressive emaciation.

Once symptoms have developed death is the end result. There have been claims made that a few animals have recovered, but it is an extremely difficult point to prove, and, for all practical purposes, it should be assumed that once the disease can be diagnosed with certainty the animal is beyond recovery.

Diagnosis

Accurate diagnosis, even *post-mortem*, in suspected cases of Johne's disease is not always easy. Often the services of a laboratory, or at least the use of a microscope, are necessary. Points in favour of a positive diagnosis are: (1) the presence of submandibular oedema; (2) an unexplained fall in milk yield; (3) an unexplained loss of flesh; (4) a tight skin; (5) a rough staring coat and (6) diarrhoea.

In the early stages the diarrhoea tends to be intermittent and can be controlled by astringent medicines or by housing the animal and feeding dry foods. Eventually, however, the bouts become more protracted and are not controllable by medicaments. During these attacks of diarrhoea the faeces are passed in a steady stream with no signs of straining (Fig. 7). They may be of a very fluid consistency and are always dark in colour and homogeneous in texture. Small bubbles are usually seen on the surface of the dung for a short time after it has been dropped (Fig. 8). A light-coloured watery faeces sample containing easily visible particulate matter in suspension is not likely to be from a case of Johne's disease.

When diarrhoea is present it is worthwhile seeking acid-fast bacilli in smears of the faeces stained by the well known Ziehl-Neelsen technique. Characteristic small acid-fast bacilli occurring in clumps of 3 to 5 or more is conclusive evidence of Johne's disease (Fig. 9). Unfortunately the absence of such bacilli does not merit a negative diagnosis as, on a single examination, the bacilli are found in only about 30 per cent. of positive cases. A simple new technique of smear preparation has been developed at the Glasgow Veterinary School and there are good indications that this will greatly increase the accuracy of diagnosis by the microscopical examination of faeces.

FIG. 7.—A clinical case of Johne's disease. Fluid faeces being passed in an unbroken stream.

Diagnosis by cultural examination of faeces is not of much importance outside the laboratory. It is true that by this method *M. johnei* can be detected in the faeces many months prior to the appearance of symptoms, but the long period of incubation required to get a primary growth (2 to 3 months) largely nullifies the usefulness of the result. Here also a negative result has little significance.

Allergic reactions have often been used in the past for the diagnosis of Johne's disease but they are not much in vogue at present. No doubt a cow with Johne's disease will often react quite strongly to johnin or avian tuberculin but the reaction tends to fluctuate and often disappears entirely during the late stages of the disease. Since cattle not affected with Johne's disease also, on occasion, react to these products confusion is complete.

Of the serological tests both the agglutination and the complement-fixation have been tried but currently only the latter is in use. The old problem of cross-reaction with mammalian tuberculosis has been avoided by restricting the use of the test to tuberculosis free herds. Variations in the method of doing the test have been introduced and these are claimed to have further increased its specificity and to have overcome the phenomenon of anticomplementary action associated with some bovine sera.

Since complement-fixation testing for the diagnosis of Johne's disease was reintroduced in its modified form about 7 years ago a number of reports on its use on the Continent, in New Zealand and in Britain have appeared. All are agreed that the test will be positive in about 95 per cent. of cattle with clinical disease, or showing extensive intestinal lesions *post-mortem*, and this must be regarded as very good for a biological test. Unfortunately when the test has been applied to cattle which are free from Johne's disease the results have not been so impressive. Cattle harbouring *M. johnei* in their lymph nodes but without intestinal lesions often pass the test and quite a high proportion (10 to 20 per cent.) of the cattle in some herds known to be free from the disease have given a positive result.

While dealing with allergic and serological reactions in Johne's disease it is of interest to note that the 2 reactions (*i.e.* the allergic response and the presence of complement-fixing antibodies) seem to be quite independent of each other and may in fact be the result of 2 different antibodies. It is probably true to say that nearly all cattle infected with *M. johnei* will give a positive reaction to avian tuberculin or johnin at some time during the course of the infection. This reaction usually reaches its peak a month or so after infection and thereafter fluctuates between some degree of reaction and no reaction until intestinal lesions become extensive when the reaction is likely to be minimal. The complement-fixation test, on the other hand, develops much later (up to 1 year after infection) and, although fluctuations do occur, it becomes more certainly positive as the intestinal lesions become more advanced.

From the above it will be realised that the complement-fixation test is at its most accurate when intestinal lesions are well advanced, consequently it is most useful in helping to reach a diagnosis in a clinically suspect animal. Also it should be remembered that its use as a herd test is still undergoing investigation and trial.

The ultimate diagnosis is, of course, the result of the *post-mortem* examination, and here we need only concern ourselves closely with the intestine and its associated lymph nodes. The carcase itself will probably be showing a varying degree of emaciation but often a surprising amount of abdominal fat is present—of course there may be virtually none. The mesenteric lymph nodes are said to be swollen and oedematous, and this is often the case but, just what degree of swelling and oedema constitute abnormality is difficult to decide. The lymph nodes are, however, a good source of material for microscopical and cultural examination, and it has been shown that the most frequently positive node is the last of the mesenteric chain, often called the ileocaecal which lies embedded in the fat in the angle formed by the junction of the ileum with the caecum.

If, on opening the intestine, one is presented with a picture such as that shown in Fig. 1 there is no doubt that the case is one of Johne's disease. Fig. 2, however, shows that marked thickening and corrugation do not always accompany clinical disease. The position is complicated even further by the fact that in some cases the intestine is apparently thickened and corrugated yet Johne's disease is not present (Fig. 10). In these cases the thickening is often due to the muscular contraction of an empty portion of intestine and such corrugations tend to have a longitudinal direction. Gentle stretching in a transverse direction will often pull out these corrugations and leave the mucous membrane smooth and thin.

In all cases of doubt a smear of the mucous membrane, stained by Z.-N., should be examined for the presence of acid-fast bacilli. If this is unrewarding a portion of the intestine should be subjected to histological examination. If the macroscopic examination has not automatically selected this portion, it should be taken from the last few feet of the ileum, as the information at present available suggests that lesions are most frequently seen in this region.

Prophylaxis

Vaccination against Johne's disease has been extensively used in France and subjected to a considerable trial in both Britain and Iceland. The results indicate a significant degree of protection. It is not certain, however, that the use of the present vaccine in cattle will not interfere with the correct interpretation of the tuberculin test and, at the present time, a field trial is in progress and free vaccination is being carried out by the Animal Health Division on farms where a Johne's disease problem is known to exist. This scheme is open to both attested and non-designate herds.

Until more is known about the vaccine its use is being restricted because of its possible interference with the tuberculin test. It has been found that vaccinated cattle can contract tuberculosis and that this cannot be diagnosed in them by the present method of tuberculin testing. It can be well imagined how serious this could be to the present tuberculosis eradication programme. A vaccine which will not produce skin sensitivity is being sought.

Simple hygienic measures may have a marked effect in reducing the incidence of clinical Johne's disease. During the war, and immediately post-war years, heavy culling of unproductive animals was practised and many herds which at that time were experiencing heavy losses are free from the clinical disease to-day.

At one time the immediate removal of the newborn calf from direct and indirect contact with adult cattle was thought to be the solution to the problem. Unexplained breakdowns, however, continued to occur in herds where this was being practised. It is now believed that these were the result of intrauterine infection and it is recommended that calves born from cows showing clinical signs of the disease, or which become clinical cases shortly after calving, should not be reared.

Calves may excrete *M. johnei* in their faeces long before there is any evidence of disease, and consequently rearing in individual pens for as long as practicable is recommended.

Therapy

Johne's disease is still on the list of incurable diseases. For a time it was hoped that one or other of the antibiotic or chemotherapeutic agents which had proved so helpful in the treatment of tuberculosis in man might have been effective. So far these hopes have not been realised. Although streptomycin and isonicotinic-acid-hydrazide both have some antibacterial effect *in vitro*, attempts to cure the disease by means of them have failed. Agents designed to cure and contain tuberculosis and leprosy are still being sought and produced, and there is always the hope that one of these may also be effective in Johne's disease.

To-day the problem of Johne's disease remains unsolved. Although its causal organism has been recognised for over 50 years there remain wide gaps in our knowledge of the bacillus itself, the pathogenesis of the disease, how to diagnose it and cure or prevent it. These problems are all being actively pursued in our laboratories to-day and there is no reason to believe that this disease, troublesome though it is now, will not one day be brought under control as have so many others in the past by early diagnosis, or vaccination or even simple hygiene. Indeed the situation could be completely transformed overnight by the discovery of a really effective therapeutic agent.

Acknowledgment.—I wish to record my thanks to Mr. Hole of the Ministry of Agriculture, Central Veterinary Laboratory, Weybridge, for the help given by his department in the preparation of the photomicrographs.

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Infectious White Scour in Calves

BY

C. M. GOULD

Southampton

SUMMARY.—1. *An outbreak of infectious white scour in calves caused by* Escherichia coli *resistant to the tetracyclines and partially to streptomycin is described.*

2. *Its course is followed by rectal swabs and direct plating.*

3. *Its spread, treatment, and control is described.*

4. *The features of the epidemic are discussed.*

5. *Prevention of outbreaks in calf buying and raising establishments is discussed.*

Description of the Farming System

Two milking units—J, a Jersey herd, and F, mainly a Friesian herd—send their calves to a common calf-rearing unit, 1 to 3 days after birth. F, a bail, had never previously experienced infectious calf scour; J, a milking parlour and yard with a single calving box-cum-sick pen, had experienced it, but not since the calving box had been taken out of use. The organisms associated with the previous epidemic at J. had been typed as *E. coli* resistant to all 3 tetracyclines and not very sensitive to streptomycin. The infection had arisen soon after high-level oxytetracycline* prophylaxis had been introduced, successfully at first. Swabs from calves of unit F had never shown resistant *E. coli*.

As soon after birth as possible all calves were injected subcutaneously with 10 ml. of a proprietary white scour antiserum and at a separate site with 33⅓ per cent. sulphadimidine (Jerseys 5 ml., Friesians 10 ml.). On arrival at the rearing unit this injection was repeated. The calves had suckled their mothers before being taken away, and a supply of mothers' colostrum or milk was taken with them for the next 2 days.

The rearing shed was divided into 3 parts: an upper shed which contained only calves free from infectious white scour and with no contact with the infected building; a lower shed which contained calves which had been in contact with the previous epidemic and had survived with or without showing clinical signs; and a central area of bare flooring upon which straw kennels had been erected to house non-infected calves from J before the upper shed had been completed. The upper shed included a pen at the lowest drainage-fall end which, equipped with an infra-red lamp, was intended for sick or weakly calves.

History of the Epidemic

With the re-use of the calving box by a new manager who did not know its previous history the following events occurred:—

Day 1. Two Jersey calves, J.1 (3 days old) housed in the calving box since birth and now beginning to scour, and J.2 (2 days old and healthy) were picked up from the infected calving box at J by a van which

* Terramycin.

proceeded to F, picked up a healthy Friesian calf, F.1, and then took them all to the rearing unit. The journey took 15 to 30 minutes. J.1 was put in the sick pen in the upper shed, J.2 and F.1 were put in a straw kennel in the central area.

Day 2. In the evening both J.2 and F.1 were obviously ill and were put in the sick pen in the upper rearing shed.

Day 3. The writer was called in in the afternoon to find F.1 dead, J.1 critically dehydrated, and J.2 beginning to scour. *Post-mortem* examination of F.1 revealed a haemorrhagic abomasitis. The clinical picture and a knowledge of the past history led to a diagnosis of infectious white scour, probably resistant to tetracycline. This diagnosis was confirmed by rectal swabs from J.1 and J.2, and swabs from the rumen, abomasum, and small intestine of F.1 (plates read the following morning).

J.1 and J.2 each received ½ g. chloramphenicol* intramuscularly and ½ g. *per os*. A pint of saline was given to each subcutaneously. Water only was permitted.

J.1 died that night.

During the day another young calf, J.3 from J, not *via* the calving box, was put in the straw kennel in the central area.

Day 4. J.2 was better. Rectal swabs revealed only two colonies of *E. coli* on the plate, both tetracycline resistant. This calf received ½ g. chloramphenicol intramuscularly and ¼ g. *per os*, together with 1 pint glucose saline in the morning, and ¼ g. *per os* in the evening. This calf was then moved to a new straw kennel in the central area. Water only was given that morning, but ½ pint milk and 1 pint water was given in the evening.

At least 3 calves in each of the other pens in the upper rearing shed were sampled and found to contain only tetracycline-sensitive *E. coli*.

At least 3 calves in each of the pens in the lower rearing shed were also sampled and found to contain only tetracycline-resistant *E. coli*. Later these organisms were shown not to be Type 026 which is known to be able to cause infectious white scour but the organisms involved in the previous epidemic which could not be typed.

The calf J.3 in the central area was sampled and found to contain about 50 per cent. tetracycline-resistant *E. coli*, which brought to light the fact that J.2 and F.1 had been housed there on Day 1.

Day 5. J.2 relapsed and rectal swabs revealed the presence of many tetracycline-resistant *E. coli*. Later this organism was shown to be Type 026.

J.3 had started to scour; rectal swab examination revealed the presence of 100 per cent. tetracycline-resistant *E. coli* organisms.

The method of treatment was therefore re-assessed.

It was decided to attempt to eliminate *E. coli* from the gut of those two affected calves and to prevent re-infection by moving them to a fresh house. Since contamination of the calf and its surroundings by its own faeces was inevitable, the calves were moved twice, and the aim was to have enough chloramphenicol in the faeces to eliminate the *E. coli*.

Each calf (J.2 and J.3) was given 1 g. chloramphenicol *per os* in the morning. They were then moved to separate kennels in another disused building that afternoon. Both received ½ g. chloramphenicol *per os* in the evening. Three rectal swabs which were taken from each calf that evening were all negative for *E. coli*. Each calf then received 1 pint glucose saline subcutaneously and water only *per os*.

Day 6. 1 g. chloramphenicol was given to each calf *per os*. The calf was washed well in soap and water, dried, and then moved to fresh straw kennels in another building: ½ g. chloramphenicol was given *per os* to each immediately after this move. They were now scouring mildly, the only organisms present being *Proteus vulgaris*. Each received water only on this day.

Day 7. Milk was gradually re-introduced into the diet.

Day 9. Swabs were again taken. J.3 had only tetracycline-sensitive *E. coli* and *Proteus vulgaris* present, while J.2 still had a few tetracycline-resistant organisms.

Day 12. After a very cold night J.2 and two other calves in the lower rearing shed had begun to scour again. Tetracycline-resistant *E. coli* were found. These were each given 1½ g. chloramphenicol *per os* in the morning together with ½ to 1 pint glucose saline, depending on the severity of the scour. They were given water only during the day. They were then washed, dried, and moved into a fresh straw kennel in the central area where "normal" cow faeces had been placed along the lowest side on top of deep, fresh straw to "infect" them. This was not allowed to become too wet. The faeces were collected daily from the cowshed where 3 cows and 2 bulls were housed each night (the cows being turned out to grass each day and also given hay and cake). Faecal samples had been taken which showed that this material contained *E. coli* organisms sensitive to streptomycin, the three tetracyclines, and chloramphenicol together with faecal streptococci which were also sensitive to these antibiotics. That afternoon each animal was given 1 g. chloramphenicol *per os* and this dose was repeated on the following morning. The increased dose was given because of the partial failure of the first method: however, this time the animals were only moved once.

Day 15. Faecal streptococci and *Proteus vulgaris* only were found in these calves. It was decided to try to "infect" the carrier calves in the lower shed by placing "normal faeces" in contact with them without concurrent antibiotic treatment.

Day 18. Two pens of calves in the lower rearing shed which had been weaned onto early weaner pellets, hay, and water, were swabbed after having been placed in contact with the normal cows' faeces since Day 15. Only faecal streptococci and *Proteus vulgaris* were found. This observation was welcomed with relief since the segregation of these carrier calves was becoming a problem. The weaning of all carrier calves was carried out as soon as possible.

* Chloromycetin; Parke, Davis & Co.

Day 25. All carrier calves were swabbed and found to contain only faecal streptococci and *Proteus vulgaris* with the exception of one pen where the calves had not been weaned. Two newly introduced unweaned calves in the lower range of buildings were now carriers. One broke down on Day 26. This was another example of faulty management. They were not Type 026.

Methods

A rectal swab was taken by enclosing the finger in freshly unwrapped cotton wool and inserting it into the rectum. This swab was then smeared directly across a nutrient agar plate (the only ones available in such quantities at such short notice). A sensitivity tablet was placed at one end of the smear, and the plate was then incubated overnight at 37° C. It was found that with practice 6 smears per plate were possible though 3 or 4 formed the most convenient arrangement.

A pure culture of the *E. coli* organisms was tested for agglutination against the proprietary antiserum, first by the slide-agglutination test (like B.W.D. without the dye), and then by titration. Similarly, it was tested against standard sera.

Results

Tetracycline-resistant organisms grew up to the tablet on the plate, whilst tetracycline-sensitive organisms did not.

The organism involved in the initial outbreak was found to be 026 and was agglutinated by the proprietary antiserum at a dilution of 1:320.

The organisms present in the lower shed and associated with the previous epidemic were not Type 026.

Discussion

The whole epidemic was followed by rectal swabs and the following points were of interest:—

1. The rapidity with which the infectious *E. coli* replaced the normal coli flora of the alimentary canal of the calf.

2. The correlation of a relapse with an incomplete elimination of the infectious coli flora or re-infection from the housing. In the writer's experience relapses are characteristic of infectious white scour and are rarely associated with digestive scour, unless the fault in management remains uncorrected.

3. Effective control depends on the elimination of the infectious flora and a change of housing to prevent re-infection. Early weaning coupled with "infection" with normal faeces containing faecal streptococci may be another reliable way of eliminating carriers, as it was in this case. Where new buildings were being used, unless normal faeces were added, no change of flora occurred, presumably because there were no faecal streptococci present. Another explanation of this could be chance—the infection by streptococci being co-incidental with the change of management—but this seems unlikely since in this case a change has now occurred three times.

4. The method of coli elimination used is expensive, and it is hoped that cheaper and more efficient methods will be devised.

5. Rectal swabs are a useful aid in the control of an epidemic of white scour even if the infectious organisms are not readily differentiated. They are also a useful tool in assessing the coli elimination dose of the antibiotic.

6. The apparent inability of an active white scour antiserum to prevent scour. In this epidemic, however, the 026 organism was identified only in a relapsed case. Again, 20 ml., the minimum recommended dose, not 40 ml., the maximum, had been given. Thirdly, other infectious tetracycline-resistant organisms were present, each thought, because of the varying biochemical fermentations, to be specific to its own pen, as could be expected from the lack of spread from pen to pen. Despite this, the recovery of this organism in pure culture from a calf which had received the antiserum may cause one to revalue the dosage and/or efficacy of *E. coli* antiserum.

7. The ease and rapidity with which the activity of the antiserum can be assessed roughly by a slide-agglutination test, though of course, later confirmation would always be desirable.

8. The lack of spread in the upper shed was due to several, if not all, of the following features:—

a. The drainage of the sick pen was away from the other pens.

b. The walls of the pens were solid and higher than the calves, so that the risk of direct contact was nil.

c. The calves were bucket fed from outside the pen—the attendant therefore did not have to enter the pen unless he was handling a sick calf or putting down more straw.

d. The bedding was well strawed up and dry deep litter was used.

e. The atmosphere was dry—this may have prevented aerial spread—though whether this is a serious risk or not the author is not sure.

9. A special sick pen for calves can be a dangerous source of infection unless disinfected effectively after use or dismantled. It should not be in the main calf pen—it is better to move the sick calf rather than risk a build-up of infection.

10. This infectious white scour organism was resistant to the tetracyclines and arose after oxytetracycline* prophylaxis had been introduced to prevent infectious white scour, at first successfully.

Prevention of Outbreaks of Infectious White Scour in Calf Buying and Rearing Establishments

The two main routes of infection are contact with either an infectious calf or an infected building. When calves are brought from different and often unknown sources, the success of prophylaxis must depend on the elimination of the *E. coli* resident in the calf, which is potentially infectious, and its replacement by a flora known to be non-infectious. Soon after low-level antibiotic feeding is introduced a resident resistant flora arises. Since this flora is generally non-infectious (otherwise the antibiotic will not

* Terramycin.

Concluded in columns 1 and 2 overleaf

Chlortetracycline* as a Preservative for Fresh Meat and Poultry

BY

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SUMMARY.—10 cattle, 5 sheep, and 10 goats were treated with chlortetracycline (Acronize M) by intravenous, intramuscular or intraperitoneal injections 4 hours prior to slaughter while the spray method was applied to fully dressed and trimmed carcases. Eviscerated carcases of chicken were dipped in a watery Acronize pd solution without ice. The treated and control carcases were transported and stored under varying tropical and semi-tropical conditions. Regular tests were carried out at 48, 72 and 96 hours.

The results obtained show that Acronize cannot combat lack of sanitation nor can it be used to cover up the poorness of a carcase. When injected intravenously or intramuscularly 4 hours prior to slaughter, it is able to delay decomposition of beef up to 96 hours. An extension of the keeping time such as this, however, may prove of value to meat hygiene and economy in countries devoid of a network of cold stores and refrigerated transport facilities.

The intramuscular injection into the neck behind the occipital bone of cattle is suggested for commercial slaughter because of its simplicity and effectiveness.

The colour and texture of the treated beef shows marked improvement.

Clostridial growth is controlled but the development of Proteus vulgaris *and yeasts is not suppressed.*

The prolongation of the storage life of meat derived from small stock is not equal to that of beef and depends upon the quality of the carcase.

The standardised Acronize process for poultry, (without the addition of ice) does not prolong the "shelf-life" of birds.

The accumulated assay of all treated meat samples shows either negative results or negligible amounts of antibiotic residue.

IN recent years much research has been devoted to the prevention of bacterial spoilage of perishable foods, particularly fresh red meat (Goldberg *et al.*, 1953; Jay *et al.*, 1957; Taylor, 1956). As antibiotics are effective in inhibiting the growth of micro-organisms and relatively non-toxic, they constitute a group of substances of potential value as food preservatives. Since, however, spoilage in fresh foodstuffs is caused by a large number of bacterial species, the antibiotic requires to have a wide range of activity. The present "broad-spectrum" antibiotics are tetracycline, oxytetracycline (Ginsberg *et al.*, 1957) and chlortetracycline. The latter, known under the trade mark of Acronize, has been selected for these trials which were undertaken to ascertain its value as a preservative for use in the transport and storage of beef, mutton, goat meat and poultry in countries where refrigeration facilities do not exist.

If a preservative, other than cold storage, could prolong the keeping quality of meat, much waste would be prevented, the standard of meat hygiene would be improved and less difficulty would be experienced in moving livestock from growing into urbanised consuming areas. The effect of such a preservative would also meet fully the demands of

* Aureomycin: Acronize. American Cyanamid Company.

Infectious White Scour in Calves—*Concluded.*

have "worked"), fresh batches of calves introduced into the buildings and given the antibiotic will have their antibiotic-sensitive organisms eliminated and replaced by the antibiotic-resistant flora of the buildings. This method will be successful as long as no infectious organisms resistant to the antibiotic used enter or arise in the shed.

It would be interesting to know how long the antibiotic supplement must be continued before the flora becomes established and whether the beneficial effects observed are correlated with this. If so, perhaps the method could be speeded up and cheapened by an initial coli-elimination dose and a low-level dose for the next few days to ensure a satisfactory replacement by the resident organisms. Rectal swabbing could possibly be used as an additional safeguard but it would be no guarantee since infectious scour organisms can become resistant to antibiotics very rapidly if they are not eliminated quickly.

If an epidemic occurs, infected calves should be segregated and treated by one of the three following methods, depending upon the expense warranted:—

1. Supportive treatment and coli elimination.
2. Supportive treatment and coli reduction with the risk of relapses.
3. Supportive treatment and/or slaughter.

Contact calves and calves which have recovered from the disease but still retain the coli organisms should remain segregated until these organisms have disappeared. Early weaning and normal organism infection may be the best method here.

Infected pens should be cleaned, disinfected, and restocked cautiously, preferably with weaned animals at first.

The ease and speed with which a tetracycline-resistant organism can be identified (and thus up-to-date knowledge of the position maintained) is certainly one advantage.

Acknowledgment.—I wish to thank Dr. R. I. Hutchinson, M.D., D.P.H., for the serological and biochemical tests she carried out for me and for the helpful discussions we had.

consumers in most countries in Africa and Asia who generally refuse to eat chilled or frozen meat.

Experimental Methods and Material

In Kenya, where the meat industry is rapidly developing, there are at present three up-to-date meat production centres. Considerable distances have to be covered and refrigerated transport is only available to those who have access to the railway. If a preservative agent were effective in prolonging the life of fresh meat, centralisation of meat production would be possible, as carcases could be transported by road to any part of the country in fresh condition, despite lack of refrigeration.

As many other underdeveloped countries share similar difficulties, it was decided to use Athi River, situated at an altitude of 5,000 feet, and Mombasa meat works at sea level, as the two slaughtering centres from which meat preserved with Acronize was to be despatched, under various transport conditions, to storage. The Nairobi Municipal Poultry Abattoir, although by no means up-to-date, was used for the slaughter and preservation of chickens because of its suitability for these trials. The tests were carried out during the short rains, a time most detrimental to the keeping quality of meat owing to very high humidity.

The experimental animals were composed of 10 zebu type cattle, 5 fat tail sheep, 10 goats and 24 chickens of mixed breed. Cattle, small stock and chickens were divided into 4 experimental groups. In the case of cattle and small stock, each group comprised 5 animals, 4 being treated with chlortetracycline and one acting as a control. For each 1,000 lb. of live-weight, 5½ gr. of Acronize were dissolved in 20 c.c. of water and injected intravenously, intramuscularly and intraperitoneally. For spraying carcases 15 gr. of chlortetracycline were dissolved in 10 litres of water. The poultry dip was prepared in accordance with a standard process controlled by patent rights and administered by the American Cyanamid Company, ice, however, being omitted. Acronize was added to the dipping tank to give an effective concentration of 10 p.p.m. of antibiotic. Tank concentrations of 20 p.p.m. and 30 p.p.m. of chlortetracycline were also used for experiment.

Intravenous, intramuscular and intraperitoneal injections were given 4 hours prior to slaughter. The intravenous injection, consisting of 10 c.c. of Acronize solution, was introduced into the jugular vein after the animal was adequately secured or, in the case of sheep and goats, after they were laid down. The intramuscular injection of 20 c.c. for cattle and 10 c.c. for small stock was given into the neck muscles behind the occipital bone. The intraperitoneal injection of 20 c.c. was administered into the right paralumbar fossa. The spraying of carcases was performed with an ordinary hand-operated spray pump after the dressing and trimming operations were concluded.

The slaughter and dressing of cattle and small stock was carried out in the normal way but, instead of moving the sides into the cold store, all experimental carcases were left in a ventilated hanging hall to lose their body temperature.

The quarters of meat were removed from the factory, (a) in an up-to-date insulated motor van, where the individual quarters could remain in a hanging position; (b) lying in the back of a station wagon, or (c) in a primitive African push-cart. The quarters, which were despatched in an insulated van from the Athi River meat works, were taken to a European butchery in Nairobi, some 20 miles distant. They were then hung on individual hooks to reap the full benefit of the natural circulation of air in such spacious premises. The other quarters from the Athi River factory were taken to a local African butcher's shop in a poorly constructed and unhygienic push-cart. Even after reaching the shop, there was little change for the better in conditions. Here, as the available space was limited, the quarters of meat were hung crowded together, even touching one another, in a cupboard. This cupboard, which was covered with mosquito netting, prevented the entry of flies but excluded satisfactory ventilation.

The meat produced in the Mombasa works, however, had to undergo by far the most rigorous trials. To begin with, the temperature on the day of slaughter was 89° F. and the relative humidity 100 per cent. Yet despite such unfavourable atmospheric conditions, the carcases were not allowed to remain for any length of time in the hanging hall of the abattoir. Instead, following local custom, at sunset the quarters were wrapped up in stockinet and hessian and placed in the back of a station wagon which then left Mombasa for its 330 miles up-country journey to reach the Kabete Veterinary Research Laboratory, situated at an altitude of 6,000 feet, at 6 a.m. the following morning. Here, at 8 a.m., the quarters were unloaded and unwrapped, and then hung individually in a well-ventilated meat store.

The second lot of meat in Mombasa was removed to a large local European butchery by an insulated van of the Kenya Meat Commission. In the butchery premises the quarters were hung separately in a passage where, during the height of the monsoon, there was some natural ventilation. Since, however, the night temperature at the time of the trials failed to drop below 76° F. and the relative humidity remained almost constantly in the region of 85 per cent., even this passage did little or nothing towards keeping the meat fresh.

The chickens used in these experiments were procured from African producers and had received no drug treatment prior to slaughter. They were kept without food for 24 hours, and on *ante-mortem* inspection were found to be in good health and reasonable condition. They were bled without stunning, plucked, while still warm, and hot-eviscerated by hand on a cement slab. The lungs and kidneys were left in the carcase and the neck was inverted into the thorax. The body cavities were not washed out after evisceration. The birds were then immediately dipped in water containing Acronize. In this solution, the carcases remained for 30 seconds, ½ hour and 1½ hours respectively. The birds were despatched by train or car, individually packed in cardboard

containers. Sampling of the poultry carcases for bacteriological examination was carried out when an "off" odour became noticeable.

All samples taken from fresh red meat and chickens were assayed for the chlortetracycline activity by using the Kohler-Abbey method of the American Cyanamid Company.

For the purpose of bacteriological examination, measured intact carcase surfaces were swabbed with calcium alginate wool swabs. These were then dissolved in ¼ strength Ringer's solution containing 1 per cent. sodium hexa-meta-phosphate. Serial 1 in 10 dilutions were made using a standard technique and 1 drop of each dilution was added to a nutrient agar plate using "50 drop" pipettes.

To procure deep tissue samples, the carcase surface was cleansed with alcohol and a wedge-shaped incision made to remove about 40 grammes of flesh, from which 10 grammes were aseptically separated and ground in an Ato-mix container with 90 c.c. of sterile distilled water. Serial 1 in 10 dilutions were then prepared in ¼ strength Ringer's solution using a standard technique.

Using "50 drop" pipettes, a drop of each dilution was added to nutritive media in Petri dishes. Thus 1 drop from the container was equivalent to 10^{-3} grammes and subsequent dilutions gave 10^{-4}, 10^{-5} grammes, etc. From this a count of the number of bacteria was made (Miles & Misra, 1938).

Nutrient agar plates were incubated for 48 hours at 37° C; Sabouraud's maltose agar was left at room temperature for up to 4 days, and the oxoidiron-sulphite agar was incubated for a week to 10 days at 37°C.

The *p*H of the examined meat was determined with the help of a Marconi meter after the samples had been macerated.

Results*

1. *Cattle and goats slaughtered in the K.M.C. Abattoir, Mombasa, and sent to a European butcher's shop in Mombasa.*

Despite most unfavourable weather conditions for the storage of fresh meat, the beef carcases, which received intravenous and intramuscular injections, remained fresh and retained their colour for 96 hours after slaughter, whereas the controls developed gaseous decomposition after 48 hours.

A very faint odour only was noticed after 96 hours when the capsule of the hip joint was opened. The good appearance of both carcases was borne out by the deep tissue count. The surface was dry and not unduly darkened but, in places devoid of a covering layer of fat or where the muscle was incised, yeasts were evident.

The intraperitoneally treated carcase showed, in the deep tissue samples, an abundant growth of *Proteus vulgaris* and chromobacterium after 48 hours.

The picture of the goat carcases on the other hand was less encouraging. When examined after 48 hours at about 9 a.m., they were dark and thickly covered with yeasts. At 11.30 a.m. decomposition had already advanced so far as to spread a repugnant odour throughout the butchery. Removed to the *post-mortem* room of the abattoir and examined after 72 hours, they proved to be completely decomposed. It was, therefore, decided to take no further samples, particularly as they had to be flown in vacuum flasks packed with ice to the laboratory at Kabete. The very poor condition of these carcases was probably responsible for the lowering of natural resistance to putrefaction. Clostridia were observed in the control and fairly heavy streptococcal contamination seen in the sprayed carcase. Lacto-bacilli were found to be present in the carcase treated by intraperitoneal injection.

2. *Cattle and goats slaughtered in the K.M.C. Abattoir, Mombassa and sent by road to Kabete.*

The carcases removed from Mombasa in the back of a station wagon benefited from the cold of the night, augmented by the strong air currents produced by the fast moving vehicle. In consequence, they remained in a better state of preservation than the carcases retained at Mombasa. The sprayed beef side gave a very small surface count at 48 hours and the quarters treated with intramuscular and intravenous injections remained in perfect condition throughout the 96 hours. In view of the initial rough treatment to which these carcases had been subjected and the fact that the control was already evincing a slight odour after 48 hours, the preservative action of chlortetracycline would appear to have been adequately demonstrated. Fungoid growth, although less pronounced than on the carcases held in Mombasa, was noticeable during the last testing at 96 hours. Staphylococci and streptococci in small numbers were also seen in the sprayed and intraperitoneally treated carcases.

The condition, however, of the goat carcases was again disappointing, the meat proving unfit for human consumption after 48 hours. Their decomposition was less rapid than that encountered in those retained at Mombasa and sampling was therefore possible over 96 hours. *Proteus vulgaris* and chromobacterium were grown from deep tissue samples. A fairly high staphyloccocal count was also registered in the intraperitoneally injected and sprayed carcases. The intramuscularly treated sides showed some clostridial growth at 96 hours when the control was already in an advanced state of gaseous putrefaction.

3. *Sheep slaughtered in the K.M.C. Abattoir, Athi River and sent to a European butchery in Nairobi and to a local African shop.*

All treated carcases sent to the European butchery remained fresh for 72 hours, but their appearance was somewhat spoiled by an even layer of yeasts.

The carcases stored in the African butcher shop kept reasonably well for 48 hours. After 72 hours, they became dark in colour and a faint odour was noticeable. Moderate clostridial contamination developed in the intraperitoneally treated carcase at 96 hours.

*Detailed Tables may be obtained direct from the authors on application.

4. *Cattle slaughtered at the K.M.C. Abattoir, Athi River, and sent to a European butchery in Nairobi.*

All sides, including the control quarters, kept well for 72 hours but the intramuscularly, intravenously and intraperitoneally treated carcases continued to keep well for 96 hours. The predominant organisms in all treated quarters were yeasts, particularly in places devoid of a flat covering. Slight streptococcal contamination was noted in the intravenously treated carcase.

A somewhat similar picture developed in the carcases held in the African butcher's shop but it showed higher surface and deep tissue counts. In this instance it was the intraperitoneally treated carcase which began to show signs of decomposition after 96 hours. Surface and deep tissue counts of the control quarters were higher than in those which had been treated. Slight streptococcal growth was noted in the intramuscularly and intravenously treated carcases at 96 hours.

5. *Chickens slaughtered in the Nairobi municipal poultry abattoir and sent to Kabete and Mombasa.*

The result of this test was disappointing. Only after doubling or even trebling the dipping strength of Acronize, was it possible to extend the " shelf-life " of birds to 48 hours and also to reduce, quite substantially, the total aerobic count of deep tissue samples. The walls of the body cavities of all carcases showed a heavy growth of yeasts.

Discussion

Antibiotics have assumed a significant role in the control of many diseases and as growth promoting factors in the animal industry. The various food trades have recently turned their attention to these substances because they show a pronounced bactericidal and bacteriostatic control over most organisms which cause spoilage in food.

As antibiotics vary considerably in their chemical structure, in their toxicity and in their selective action on bacteria and as some organisms are able to develop a resistance to them, this particular disadvantage is a cause of concern to the public health worker. The fear is expressed that, were antibiotics used as food preservatives, bacterial resistance and antibiotic sensitivity might be induced (Ross, 1957). It is, however, equally important to determine whether an antibiotic can be used as an effective preservative (Goldberg *et al.*, 1954; Jay *et al.*, 1957; Weiser *et al.*, 1953). With the aid of chlortetracycline, it was possible to prolong the keeping quality of beef up to 96 hours even under tropical conditions provided (a) the animal from which the meat was derived was healthy, or even in average or good condition, and (b) the slaughter and dressing conformed with the demands of meat hygiene. The results obtained with sheep and goats were not quite so encouraging, since the prolongation of their storage life by the antibiotic was negligible. However, in underdeveloped tropical or semi-tropical countries, a means of preservation is required primarily for beef. Sheep and goat meat is usually disposed of on the day of slaughter but the many remaining joints from the large beef carcase could be sold the following day if a preservative agent other than unobtainable refrigeration were available. Strict regulations would, of course, be necessary to control the use of such substances but, if they are used within the limits stipulated by the manufacturers, the residue, such as recorded for these trials, is so small that no bacterial resistance should be acquired, since storage and cooking will completely destroy the minute amounts remaining in the muscle tissues (Ginsberg *et al.*, 1957; Goldberg *et al.*, 1953). Some anxiety is caused, however, by the frequent occurrence of *Proteus vulgaris* and yeasts.

A method to replace refrigeration must be inexpensive, simple in application and easily absorbed within the general procedure of meat production, whilst not offending against religious scruples and local custom. Antibiotics comply with most of these demands but the best method of applying them is still under dispute. Four methods were therefore chosen in the present trials: the first 3 consisted of intravenous, intramuscular and intraperitoneal injections given 4 hours prior to slaughter. As another possible means of applying the antibiotic, a spray was used on the fully dressed and trimmed carcase after slaughter. The intravenous infusion with a Griffith pump, as suggested by Weiser *et al.* (1953) was not considered since its application is too complicated for normal commercial procedure. The intramuscular injection is a by far quicker method and can be given, without special immobilisation, whilst the animal passes through a race. As chlortetracycline tends to give the tissues surrounding the site of injection a slightly yellowish taint, the neck muscles behind the occipital bone were chosen instead of the customary buttocks. The loss of a small piece of neck meat is of no importance, whereas an excision of the hind quarters would provoke strong objection from the meat trade. The intraperitoneal and spray methods were used (Ginsberg *et al.*, 1957) but proved unsatisfactory. The main objection in the latter case was the slightly yellow staining of the carcase surface.

The preservative effect of Acronize in goat meat was disappointing. Admittedly the animals used in these trials were of low quality but they represented the normal stock for the season. The better results obtained with sheep of average condition proved that the antibiotic cannot be used to mask the poor state of the carcase nor improve its natural condition. The sole purpose of the use of this antibiotic is to prevent the development of *post-mortem* contamination by inhibiting the growth of, or even by destroying, micro-organisms.

The preservation of poultry by the standard dipping method of the American Cyanamid Company, but without the addition of ice, proved to be a failure (Kohler, *et al.*, 1955). Not until the strength of the dipping solution was doubled or even trebled could the " shelf-life " of the treated birds be prolonged by

48 hours. The treated carcases then developed a different "off" odour from the control, but the flesh remained firm and did not become slimy as in the latter (Ziegler & Stadelman, 1955). The odour was not so pronounced as in the control and was more difficult to identify. As the bacterial count of these carcases treated in stronger solutions was also substantially reduced and the antibiotic residue proved to be only 0.30 mcg. per gramme, further trials with still stronger Acronize dips require to be undertaken.

The dipping solutions used in these trials naturally did not contain ice. Indeed, the temperature of the water proved to be higher than that of the surrounding atmosphere, since the storage tank on the roof of the abattoir was exposed to the direct rays of the sun. One must, however, expect to encounter such conditions in underdeveloped countries, and, where ice does not exist, a suitable substitute must be found. These trials confirmed Shrimpton's (1957) observations that, in the absence of refrigeration, chlortetracycline in the prescribed strength does not extend the storage life of eviscerated poultry carcases.

Acknowledgments. — The authors are greatly indebted to Messrs. American Cyanamid Company, for the supply of Acronize and experimental animals; to the Director of Veterinary Services for his permission to carry out these trials; to Mr. J. A. R. King, Chairman, K.M.C., for granting facilities for these investigations; to Mr. M. Burdin, Ag. C.V.R.O., for permission to carry out all laboratory tests at the Veterinary Research Laboratory, Kabete; to Mr. P. Toone, Manager, Kenya Cold Storage, Nairobi and to Mr. W. Bell of the Grade Meat Company, Mombasa, for the use of their premises; and to Miss P. Wooding for technical assistance.

This paper was published with the permission of the Director of Veterinary Services, Kenya.

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The Anatomy of a Double Pig

BY

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SUMMARY.—An example of Syncephalus thoracopagus in the pig is reported. The anatomy of the hearts and circulatory system has been described in greatest detail in that it was in these respects that this example differed more particularly from previously recorded cases.

A PAIR of Siamese male twin pigs was born recently to a third litter sow in the University of Nottingham Experimental Farm herd of pedigree Large White pigs. Parturition was unattended, the remainder of the litter comprising 12 normal live piglets. The twin foetuses weighed 3 lb. 7½ oz., and despite their ungainly shape, were apparently delivered without difficulty. *Post-mortem* examination of the lungs showed that they were stillborn.

The embryos were joined ventrally as far posteriorly as the umbilicus, of which only the proximal portion was found. This appeared to be single, but carried a double set of blood vessels. The hind quarters posterior to the point of fusion appeared normal, both pigs possessing descended testicles and regular rows of teats. All four fore limbs were present, although somewhat displaced as a result of the fusion of the thorax. The head region showed the greatest derangement, as both heads were turned through 90 degrees, to face sideways between the right fore leg of one twin and the left of the other. One head was of normal size and well developed, but the other was much suppressed. This rudimentary head possessed a small, snout-like protuberance which concealed two eyes close together, and two ears just posterior to the eyes, all fused to the back of the normal head. It was not possible to detect a mouth from superficial examination. The external form of the twins is illustrated overleaf in Fig. 1 and Fig. 2.

Internally, the organs were essentially similar to the specimens of Syncephalus thoracopagus described by Carey (1917) and by Williams and Rauch (1917), although showing differences in detail associated with less suppression of the organs of the anterior half of the body of one of the twins. The urino-genital systems were completely double, and the alimentary canal was modified in much the same way as those of previously recorded cases. There was a single oesophagus, stomach, and ileum, which then bifurcated, the remainder of the small intestine, the caeca, and the large intestines being double. The oesophagus showed one feature of interest in that, in the area of the rudimentary face, it gave off a small, blind pouch, containing a tongue, and having two rudimentary, cartilaginous lower jaws on either side of it. The stomach was single, but had two fundic pouches, indicative of its double origin, and there were two livers of equal size.

FIG. 1.—" Ventral " view

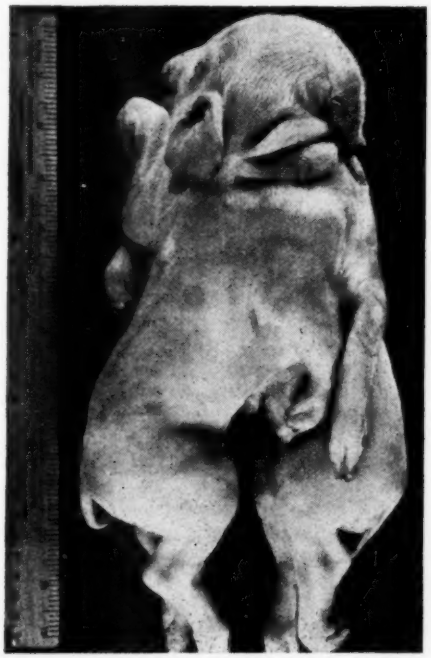

FIG. 2.— " Dorsal " view.

Two pairs of lungs were present with two tracheae leading to the one oesophagus, one epiglottis being located slightly anterior to the other. There were two hearts of approximately equal size, enclosed in separate pericardia. Both were normally developed except that the auricles of each had an enlarged foramen ovale. The circulatory system was of particular interest in that, although it was to a large extent double, having two dorsal aortae as well as duplicate sets of all the other major vessels, fusion had taken place of the two aortae to form a common aorta, with consequent alteration in the relations of the vessels around the heart. The arrangement of the major arteries is shown, somewhat diagrammatically, in Fig. 3 and also illustrated in Fig. 4.

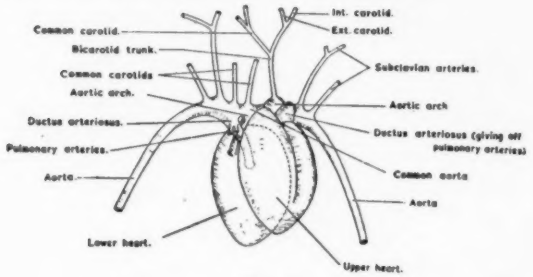

FIG. 3.

The major change was that the aortic and pulmonary arches from each heart both emptied into the common aorta, the pulmonary arteries arising as somewhat minor branches of the pulmonary arch. This was probably associated with the enlarged foramen ovale, the heart thus behaving more or less as a two-chambered organ, with no distinct pulmonary and systemic circulations. Only a small proportion of the blood from the right ventricle would enter

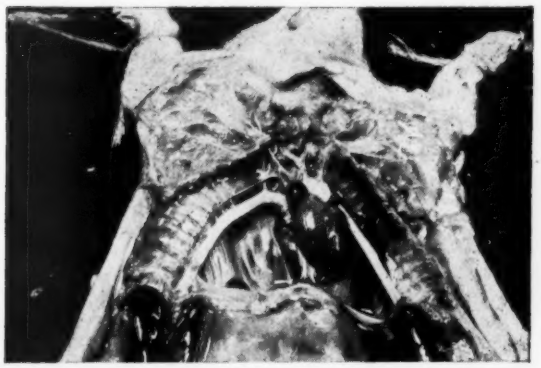

FIG. 4.— Thorax with lungs removed, showing hearts and associated blood vessels.

the pulmonary arteries, and as the venous return to the heart was arranged in the normal manner, with separate pulmonary and caval returns, without the foramen ovale to equalise the supply, there would be a progressive reduction in the blood returning to the right ventricle.

Concluded in column 1 overleaf

In Brief

The Formation of Haemoglobin

Haemoglobin consists essentially of the colourless protein globin to each molecule of which are attached 4 molecules of haem, the iron-protoporphyrin compound which gives haemoglobin its red colour. Haem is a flat molecule composed of 4 pyrrol rings joined together in a circle in the centre of which lies an atom of iron. It is found in all animal cells and its properties depend largely on the nature of the protein to which it is attached. Thus globin confers upon its haem iron the ability to combine reversibly with oxygen and so to act as an oxygen carrier between the lungs and the tissues, whereas when haem is combined with certain other proteins as in the tissue cells, it has the properties of a respiratory catalyst and takes part in the complex respiratory activity of the cell. Haem is therefore a constituent of all aerobic cells and is synthesised in them. Haemoglobin, on the other hand, is formed in the haemopoietic tissues.

It is best to consider separately what is now known of the synthesis of the parent porphyrin, the incorporation of iron, the formation of globin and the combination of the haem and globin.

Our knowledge of the synthesis of haem has advanced rapidly during the last few years. Isotope work with labelled carbon and nitrogen has shown that the materials used are the amino acid glycine and acetate. These give a compound known as δ-aminolaevulic acid. This is acted upon by an enzyme which has recently been purified, to give a compound with a ring structure, porphobilinogen. Under the influence of another enzyme system, 4 units of porphobilinogen combine to give a porphyrin, either uroporphyrin itself or its immediate precursor. This porphyrin then undergoes a series of chemical changes until finally protoporphyrin is formed and it is probably at this stage that the iron is attached giving haem.

Recent work has shown that globin is synthesised simultaneously with haem, from aminoacids derived from the breakdown of dietary protein, protein stores and the globin liberated from haemoglobin at the end of the normal life-span of the red cell when the haem is also broken down, the iron being retained in the general pool while the porphyrin is degraded to give bile pigment. Under conditions of protein depletion, precedence is always given to the synthesis of globin at the expense of other proteins such as the plasma proteins.

Other deficiencies can affect the synthesis of haem. The most obvious is simple iron deficiency leading to hypochromic anaemia. Copper is also essential for the biosynthesis of haem since in copper deficiency there is a hypochromic anaemia and also depletion of tissue cytochrome oxidase, the haem containing respiratory enzyme of the cell, but the exact role of copper in the complicated process of haem formation is not known. Pyridoxine and ascorbic acid are also required for haem formation.

One of the main lines of approach to the problems of haemoglobin formation is by the study of haem synthesis *in vitro* by the nucleated red cells of birds. In this way light is thrown on the nature of various intermediate forms of porphyrin and the enzyme systems which bring about the changes in their chemical structure. This work also promises to elucidate the problems arising in the rare inherited disorder of porphyrin formation which occurs in man, cattle and pigs. In this condition—congenital porphyria—the predominent symptoms of photosensitisation of the skin, brown staining of the teeth and bones, general unthriftiness and the red-brown colour of the urine, are due to the production and excretion of large amounts of porphyrins mostly of a different type from those which are formed during normal metabolism and which are excreted only in traces.

J. KEILIN (May, 1958).

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WOLSTENHOLME, G. E. W. & MILLAR, E. C. P. (1955). Porphyrin biosynthesis and metabolism. Ciba Foundation Symposium. Churchill, London.

The Anatomy of a Double Pig—*Concluded.*

Two complete sets of carotid and subclavian arteries were present, the subclavians of both sides arising from the common aorta and supplying the fore limbs of the appropriate side. While the carotids of the upper heart arose as a bicarotid trunk from the aortic arch, dividing into common carotids and then external and internal carotids, the carotids of the lower heart arose separately, but close together, from the common aorta, again dividing normally into external and internal branches. The carotids of the upper heart supplied the upper (large) head, while those of the lower heart led to the small rudimentary head and were consequently considerably smaller. This differed from the arrangement in the specimen described by Carey, in which each heart contributed blood to both heads. The separate blood supplies to the heads in the present specimen give a further indication that the heads were not compound. This corroborated the conclusion reached from external examination.

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Current Literature

BOOK REVIEWS

Veterinary Ophthalmology. By R. H. SMYTHE, M.R.C.V.S. 2nd Edition, 1958. Pp. 379. Baillière, Tindall & Cox. 42s.

The popularity of this book is such that within a period of two years a second edition is before us. The book has increased in size by some 21 pages by the incorporation of extracts from the literature since the first edition and the addition of new diagrams. The book has also gone through a tidying-up process and with the references to the literature at the end of each chapter it falls into line with modern practice. Congenital abnormalities have been given chapter status and promoted to the clinical section of the book. In the new edition the author has definitely found in favour of the "secretion" theory for the formation of aqueous humour —"ultra filtration" is no longer accepted. The task of a reviewer is to acquaint would-be readers of the contents of a book and to offer constructive criticism to the author. It is obvious the first requirement was fulfilled two years ago. As to the second, it is felt that some of the clinical text of the book needs trimming. Too much heavy weather is still made of the correction of entropion and ectropion. Paracentesis of the eye in deep corneal ulcer is made a most complicated and hazardous business when the use of a trephine would make the operation simple. The treatment of prolapse of the eyeball is extremely complicated and the text is difficult to follow and understand. One cannot on any account recommend the procedure of anchoring the membrana nictitans to the upper lid. Finally the reviewer is tempted to ask if in a veterinary treatise it is necessary to have so many references to the human aspect.

The text of this book as in the previous edition is in a very readable style and the presentation is good. Both author and publisher are to be congratulated. It is unfortunate but no doubt inevitable that the price of the book has been increased from 35s. to two guineas.

Leptospirosis in Man and Animals. By J. M. ALSTON & J. C. BROOM (1958). E. & S. Livingstone Ltd., London and Edinburgh. 40s.

The veterinary surgeon in this country knows of leptospirosis chiefly as a disease of dogs, and is really only concerned with two serotypes—*L. canicola* and *L. icterohaemorrhagiae*—although of course these organisms, and many other serotypes, are responsible for a variety of diseases in man, apart from the well-known Weil's disease. The importance of leptospiral disease in domestic animals is being increasingly recognised, and this book will be essential reading for those veterinary surgeons, whether clinicians, pathologists, or bacteriologists, who wish to have an exhaustive but compact (and, at the same time, an intensely interesting) account of these strange organisms and the diseases which they cause. The authors, and in particular Dr. Broom, are well known to the veterinary profession for the contributions they have made to the study of these diseases, and they have fully succeeded in their aim, which is "to tell what is known about leptospires and the diseases which they cause in man and animals, and to show where new knowledge is at present being gained and may be hoped for in the future." In achieving this aim, the authors have contrived to present a tremendous amount of information in a most attractive and stimulating fashion. Some of the Tables, for example, are very valuable summaries of information at present available.

The bulk of the book is naturally devoted to leptospirosis in man, with full consideration of the properties of the numerous serotypes and of the diseases caused by them, but there is a section of nearly 40 pages on leptospirosis in domestic animals as it occurs throughout the world. Particular attention is paid to clinical, pathological, diagnostic, and therapeutic features of leptospirosis. There is a chapter, by Mr. Charles Doughty, Q.C., on the legal aspects of the contraction by humans of leptospirosis on rat-infested premises, and so on, and there is a chapter on laboratory techniques. There are finally a lengthy bibliography, and an author and a subject index.

Some few errors appear to have crept in. Thus, Figs. 25 and 26 appear to have been transposed, and there are one or two misprints—"mytotic" (legend to Fig. 24), and "Dobberman pincher" (p. 283). Fig. 14 is not very good: it does not show clearly the patchy fibrosis of canine nephritis, and is also, according to convention, printed upside down. The space devoted to periodic ophthalmia in horses is perhaps somewhat excessive. These are, however, very minor points, and the book can be strongly recommended to veterinary students and veterinary surgeons. It is bound to become recognised as the standard work on its subject.

Pig Carcase Evaluation. By G. HARRINGTON, M.A.; Agricultural Research Council Statistics Group, School of Agriculture, Cambridge. Technical Communication No. 12 of the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh. Published 1958 by the Commonwealth Agricultural Bureaux, Farnham Royal, Bucks. Pp. 107. Figs. 4. 15s.

The pig industry to-day in the U.K. is highly competitive and demands a high standard in the quality of the product which the pork and bacon farmer produces. This technical communication on pig carcase evaluation serves a useful purpose in gathering together and summarising the literature on this subject. Divided into 6 chapters, it deals successively with the methods of estimating carcase quality, both on the carcase and on the live pig; the methods of assessing the quality of fat and of lean meat; other characteristics such as the various weights of live

pig, carcase, trimmed carcase, and cured bacon which indirectly affect carcase quality; and a further chapter on carcase evaluation in the field deals with grading, competitions for carcase quality, and the methods used in progeny testing for judging quality. The author's own opinions on this subject are contained in a final chapter in which he draws attention to the need for future research in certain aspects of carcase quality where information at the present time is lacking.

The book is a technical communication and is, therefore, by its conception, directed towards the research worker. However, its presentation makes it readable by a wider audience in all fields of animal production. The absence of an index does not detract from the value of the book since the subject matter is so subdivided as to make it easy to find individual topics.

Diagnostic Aids in the Practice of Veterinary Medicine. By H. H. Berrier, B.S., D.V.M. C. W. Alban & Co., St. Louis, Missouri. $4.

This small book by Professor Berrier comprises a list of the simplest and most practical field laboratory diagnostic procedures, together with information on the type and cost of equipment required and where to obtain it.

Addresses are also given for the despatch of specimens requiring more complex tests than are possible in the field.

The conception behind such a book is an excellent one and it is doubtless of much practical value in the area of its origin.

Readers in this country, while they may regret the lack of a similar book over here, will find the value of Professor Berrier's volume severely reduced by its travel across the Atlantic where none of the addresses, catalogue numbers, etc., can be of much help to the busy practitioner.

Biochemistry of the Amino-acids. By ALTON MEISTER. Academic Press Inc., New York and London (1957). $10.

The importance of proteins to living matter needs no emphasising and the 485 pages devoted in this book to the fundamental units of which the proteins are composed is far from excessive though much of the vast amount of detailed information in it will be useful only to those with a special interest in the field of amino-acids.

The book starts in a way which is unsettling to those whose introduction to amino-acids and proteins was not recent, as it shows that the rate of discovery of new amino-acids over the last 50 years has proceeded exponentially, with the pace showing no sign of slackening. Eighty naturally-occurring amino-acids are now known and of these practically half have been discovered during the last decade. On the other hand, the number of amino-acids recognised as forming the major constituents of proteins had remained almost constant at 21 since the turn of the century until the discovery of threonine in 1935 increased this to 22.

There are 5 chapters in the book. The first of these is devoted to the physical and chemical properties of the amino-acids. The stereo chemistry of the amino-acids is considered and the natural D-amino-acids mentioned, while a later section is devoted to analytical matters. This leads on to an interesting discussion of a number of important naturally-occurring peptides and related compounds. The second chapter deals with the rôle of amino-acids in nutrition and is concerned with the amino-acid requirements of micro-organisms, lower animals, higher animals, and cells grown in tissue culture. The chapter ends with a survey of antagonists to many amino-acids. The third chapter is concerned with the biochemical and physiological reaction of amino-acids such as deamination, decarboxylation, transamination, and racemisation, and the synthesis of peptides and purines. In the fourth chapter, which deals with intermediate metabolism, the metabolism of individual amino-acids is followed, and in the final chapter a survey is made of abnormalities of amino-acid metabolism.

The field covered is very wide and those whose interests centre round the domestic animals may be disappointed to find that some of their particular problems receive little or no mention. Interesting curiosities can be found, such as the occurrence in the urine of the cat of a large amount (120 mg. per day) of an amino-acid, felinine, which has not been found in the urine of other than the feline species; but the important transformations of amino-acids that occur within the stomach of the ruminant are not glimpsed, and the discussion of dietary requirements of amino-acids would be of very limited value to those seeking illumination on the feeding of pigs or poultry. Milk and the synthesis of its proteins do not occur in the index, the amount of information in the text scarcely justifying an entry, and the chapter on abnormalities of amino-acid metabolism is naturally strongly rooted in human medicine.

Such instances as these could be multiplied, but one must not blame the author for the slowness with which the problems of the domestic animals penetrate the academic fastnesses. The book is immensely informative, the facts having been gathered by one who has worked in this field for some time, and nearly 3,000 references are listed. It is also readable. The paper, printing, reproduction of formulae, and binding are as pleasant as one would expect in a publication by the Academic Press, though the price, like that of most American publications, is not attractive.

CONGRESS PAPERS

May we remind readers that advance Congress papers will be provided *only to those who apply for them*. Papers are now printing and those who have not yet applied and who want them are asked to notify the B.V.A. as soon as possible, preferably on the ticket application form previously circulated.

The papers and the discussions will, as before, be published in a special number of THE VETERINARY RECORD during December.

News and Comment

DIRECTOR OF THE INTERNATIONAL OFFICE OF EPIZOOTICS

The International Office of Epizootics has notified the forthcoming retirement of the Director, and applications for the post are invited.

Persons in Great Britain with the necessary qualifications who may wish to be considered for the post are invited to send their applications to the Chief Veterinary Officer, Ministry of Agriculture, Block B, Government Buildings, Hook Rise, Tolworth, Surbiton, Surrey, by November 1st, 1958. Full particulars of education, qualifications and experience should be given. Applicants must be veterinary specialists and have a good knowledge of French and English.

The post carries a salary of Frs. 3,000,000 per annum plus a further Frs. 600,000 per annum as displacement and travel compensation.

VETERINARY SURGEONS TO BROADCAST

Mr. L. Guy Anderson is to broadcast on September 24th, in "On Your Farm" (B.B.C. Home 12.30 to 1 p.m.). Mr. Roger Massey will be in the chair for that programme and also for similar programmes every Wednesday during September.

ANOTHER SUCCESSFUL R.C.V.S. PROSECUTION

Mr. Francis Joseph Corina, 53-year-old proprietor of a cattery at Odsal Top, Bradford, was fined £45 and ordered to pay 15 guineas costs at Bradford City Court last week after being found guilty of purporting to be a veterinary surgeon while giving treatment to a cat.

He had pleaded not guilty to nine summonses, alleging that he held himself to be a practising veterinary surgeon, practising while unregistered and using the description of veterinary surgeon when not registered in the Register of Veterinary Surgeons or in the Supplementary Veterinary Register.

All the offences were said to have occurred between November 30th and December 31st last year. The prosecution was brought by the R.C.V.S., who were represented by Mr. Roger Suddards.

Mr. Corina said in evidence that he was a lifelong cat lover. About 1,800 cats went through the home last year. When treatment was required a veterinary surgeon was employed. So far this year £60 had been spent on veterinary fees.

He did not inject the cat in question as had been alleged. He cleaned the abscess with cotton wool and bandaged it. "I did not say I was a veterinary surgeon on that or any other occasion," he said. "I resent suggestions that I posed as a veterinary surgeon."

Mr. R. M. Priestley (defending) said that his client had never practised for any animal treatment in any way conflicting with the provisions of the Act.

THE LIVE POULTRY (MOVEMENT RECORDS) ORDER, 1958

The Minister of Agriculture and the Secretary of State for Scotland, acting jointly, have made the above Order which revokes the Live Poultry (Movement Records) Order, 1954, and re-enacts it with amendments.

The principal amendment is the introduction of a provision requiring persons carrying on the business of slaughtering poultry to keep records of the poultry they slaughter. Where poultry are slaughtered by the Jewish or Moslem methods the records must be kept by the poulterer. This new rule is designed to assist the Ministry to pursue routine investigations into outbreaks of fowl pest.

The definition of a poultry dealer has been amended to include persons who buy poultry or day-old chicks and feed them before resale. Persons who keep the birds for at least 28 days before resale for slaughter are not dealers for the purposes of the Order.

The Order comes into force on September 1st, 1958. Copies may be obtained from H.M.S.O. price 3d. (by post 5d.).

WARNING OF FLUKE DISEASE

There are already indications, associated with the unusually wet summer, that fluke disease may be prevalent in the autumn and winter. Scientific workers in the Ministry of Agriculture would therefore like to warn farmers who have experienced trouble in past years to take special precautions, and to begin now.

Full information is given in Animal Health Leaflet No. 6. It is urged that known "fluky places" should be treated with bluestone to kill the snails which are now harbouring the infestation, that regular carbon tetrachloride treatment should be begun early, and that stock should be kept away from infested areas during the critical period of September to December. Advantage may be taken at this time of fields that were reserved for hay or that have carried a grain crop as these will be safe.

"Black disease" which is associated with fluke is also expected to be more prevalent and farmers are urged to see their veterinary practitioner about vaccination which is an entirely satisfactory means of prevention.

FIFTY YEARS AGO

A correspondent had written deploring the number of testimonials of a pecuniary nature to leading members of the profession. He had at least one sympathiser and "F.R.C.V.S.", under the title *Mr. Banham and Testimonials*, wrote:—

"Mr. Banham's remarks are such as are quite worthy of consideration, and very serious consideration. There are many of us who, although we hold similar views to those of Mr. Banham, subscribe our 'mite' on these occasions to do honour to those of our profession whom we consider deserve it, but at the same time we do so with feelings that it is carrying out the old saying 'to those that have shall be given.'

"With the idea of recognition of valuable services rendered to the profession I am entirely in accord, and I hope we shall always be in a position to confer honour where honour is due; but these occasions

are occurring with somewhat alarming rapidity and at a time when the incomes of our professional brethren are subject to 'market fluctuations' of a somewhat serious character, and, if we look back on the number of calls that have recently been made on us, and the accumulated totals of these calls, we can only arrive at one of two conclusions *viz.*, that there is a good deal more spare money in the profession than members would have us believe, or, that we are prepared to practise self-denial in a truly laudable manner to help recognise these 'shining lights' of our profession.

"That the recipients of these marks of esteem and regard fully appreciate their honour I do not for one moment doubt, and it must be a proud moment for such a man to sit in the ease and luxury of his own house and gaze on those marks of appreciation in the form of solid silver articles of ornament and reflect on the high esteem in which he is held by his professional brethren. I often wonder if he ever thinks of the other side of the picture, of the position of some of the subscribers who sent a 'mite' (perhaps when they could ill afford it), and of the still more unfortunate members who, through no fault of their own, were not subscribers owing to financial depression? It is a contrast, and an appealing contrast which, if it did nothing else, would make the honoured one sigh and reflect 'poor beggars, I am truly sorry for them.'

"By all means let us have our contributions to these marks of esteem and regard, but, with Mr. Banham, I say let us try and make the impressions a little less transient than they are. At present, an amount of £300 or £400 is collected; the honoured member is asked what he would like. He knows the amount of the subscription list, and he chooses plate or gold ornaments or something 'tangible'—he is often feasted before the presentation, and everybody after singing 'For he's a jolly good fellow' disperses —the affair is soon forgotten, until a fresh subscription list comes out when a subscriber says: 'Hallo! this is getting a bit thick, it wasn't long since old —— had his turn' and the 'deserving poor' read of all this with mixed feelings—with pleasure at an honour to a member of their profession, and with regret that 'they are not as other men are.'"

PERSONAL

Births

GILLETT.—On August 20th, 1958, to Rosemary, wife of T. G. F. Gillett, M.R.C.V.S., of Woodpecker, Holway Green, Taunton, Somerset, a daughter, Pamela Frances, sister for Fiona.

WIGHT.—On August 15th, 1958, to Frances, wife of Graham Wight, B.SC., M.R.C.V.S., Kallada, Auchtermuchty, Fife, a daughter.

COMING EVENTS

September

3rd (Wed.). Meeting of the Southern Counties Veterinary Society at the Polygon Hotel, Southampton, 7.30 p.m.

General Meeting of the South Wales Division at the Golden Grove Farm Institute, Llandilo, 2 p.m.

Meeting of the South-East Midlands Veterinary Medical Association at Glaxo Laboratories, Greenford, Middlesex.

17th (Wed.). Meeting of the North Wales Division at Glynllifon, Caernarvon.

21st to 26th (Official Opening, Monday, September 22nd). 76th Annual Congress of the British Veterinary Association in Douglas, Isle of Man.

23rd (Tues.). General Meeting and Dinner of the Royal (Dick) School of Veterinary Studies Alumnus Association at the Villiers Hotel, Douglas, I.o.M., 6 p.m.

27th (Sat.) Symposium on "Nutritional Hazards caused by Radioactive Contamination of Foods" by the Scottish Group of the Nutrition Society in Edinburgh.

October

4th (Sat.). R.A.V.C. Old Comrades' Association Annual Reunion and Dinner, Bridge House Hotel, London Bridge.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Ayr. Capringstone Farm, Dreghorn, Kilmarnock (Aug. 19).

Atrophic Rhinitis

Sussex. Songhurst Farm, Loxwood, Billingshurst (Aug. 20).

Fowl Pest

Cambs. 88 West End, March (Aug. 19); 38 Bridge Street, Chatteris (Aug. 22).

Essex. Gods House Farm, Harts Lane, Ardleigh, Colchester (Aug. 19); Fitzandrews Farm, Great Waltham, Chelmsford; Warners Farm, Great Waltham, Chelmsford (Aug. 20); Kings Head Farm, Stock, Ingatestone (Aug. 22); Coopers Lane Allotments, Clacton-on-Sea (Aug. 24).

Norfolk. The Rookery Villa, Thuxton, East Dereham; Elm Farm, Reymerston, Norwich; Oaklands Farm, Redenhall, Diss (Aug. 19); Litcham Road, Longham, Dereham; Mill Road Farm, Whitwell, Reepham (Aug. 20); Smallholding, Foxley, Dereham; Hardingham Road, Hingham, Norwich (Aug. 21); Airfield Farm, Topcroft; Hill Farm, Banham, Norwich; Mutts Farm, Denton, Harleston (Aug. 22); 8 Council Houses, Haugh Road, Banham; Yew Tree Farm, Medfield, Harleston; Common Wood, Ridlington, North Walsham (Aug. 23); Bungalow Farm, Bressingham, Diss; The Grove, Bunge Road, Loddon, Norwich; Mill Farm, Weybread, Diss (Aug. 24).

Surrey. Woodside Farm Close, Balcombe Road, Horley (Aug. 21).

Sussex. Ovingdean Hall Farm, Ovingdean (Aug. 20).

Swine Fever

Beds. Poplar Farm, Renhold Road, Wilden, Bedford (Aug. 25).

Bucks. Castlefields Farm, Buckingham (Aug. 21).

Ches. Moore Farm, Shocklach, Malpas (Aug. 25).

Denbigh. Cae Cymro, Gwern-y-Mynydd, Mold (Aug. 21).

Flints. Coed Du Smallholding, Hendre (Aug. 21); Sarn, Treuddyn (Aug. 21).

Herts. Badgers Dell, Barns Lane, Kings Langley (Aug. 25).

Norfolk. Hill Farm, Overstrand, Cromer (Aug. 25).

Salop. The Castle, Duddleston, Ellesmere (Aug. 19).

Warwicks. South Leamington Allotments, Leamington Spa (Aug. 19).

Wilts. The Mill Piggeries, Snap Farm, Aldbourne, Marlborough (Aug. 25).

Worcs. The Common, Broughton Green, Droitwich (Aug. 19); Peghouse Farm, Broadwas, Worcester (Aug. 20).

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

SCIENTIFIC

Nematodirus in Lambs: Treatment with n-butyl N-phenyldithiocarbamate

Sir,—In the County of Caithness, outbreaks of Nematodirus disease have been recognised since 1952, in March-born low ground lambs. Both *N. filicollis* and *N. battus* are involved, the latter usually predominating. The illness in lambs during which scouring, unthriftiness and deaths occur lasts for about a month in the period late May to mid-July according to the weather conditions. The incidence in the years 1955 and 1958 has been unusually high. From 1952 to 1957 various treatments were tried, but these did not influence the course of the disease. In 1958 efforts were made to prevent or alleviate the disease using the above chemical. Following the recent article by Leiper (Vet. Rec. **70,** 273) it may be of value to report some of the results of the use of this drug in the field.

Following the maker's recommendation, a dosing programme was started by one farmer for a group of 120 lambs. These were first dosed on May 20th, before they had shown any signs of the disease. A second dose of the drug was given 12 days later. In the interval these lambs had developed a severe scour and many showed marked loss of condition. There had been 2 deaths. A diagnosis of Nematodirus disease made by the local practitioner was confirmed by faeces examinations. On June 13th, the lambs were dosed with phenothiazine and in addition a small number were given the Nematodirus remedy. Of these latter 30 per cent. died within a week. No improvement was seen in the condition of the lambs following any of the doses, but by the beginning of July almost all the lambs had stopped scouring and were again thriving. Faeces examination at this time showed counts of up to 700 Nematodirus e.p.g.

On a neighbouring farm the first of 3 groups, each of 100 lambs, was dosed on May 18th; the dose was repeated 10 days later and combined with phenothiazine. The other 2 groups received the Nematodirus remedy in a single dose on May 24th and June 1st respectively. Scouring had already commenced before any lambs were dosed, but no improvement in the condition was seen following dosing. By mid-June 10 per cent. of the lambs had died and many more were in very poor condition. A *post-mortem* examination at this time revealed a relatively high Nematodirus infestation with marked dehydration, the other lesions being typical of these described for the disease.

It would seem from the first farmer's experience that n-butyl N-phenyldithiocarbamate had little or no effect on the prevention of the disease and that the contamination of the pasture by the lambs was at least sufficient to maintain a dangerous level of infestation for the following year. This finding is amply borne out by the experience of other farmers in the district. It is understood that further work is being carried out by the manufacturers of the product in order to discover the reason for the disappointing results following the use of their drug under field conditions.

By way of comparison, groups of lambs on these same farms to a total of 140 were dosed with Bephenium embonate. In one case this was done on May 20th and prevented all but a mild scour in occasional lambs. In the second farm dosing was delayed until symptoms had become more advanced, but improvement following dosing was marked and deaths stopped after a short time. This again is typical of results found on other farms in the district.

Drummond Hill,
Stratherrick Road,
Inverness.

Yours faithfully
DAVID B. R. POOLE.

July, 1958.

GENERAL

The Vetinfile

Sir,—As publishers of "The Vetinfile," recently reviewed in THE VETERINARY RECORD, we would like to thank our unknown reviewer for his long and painstaking review. However, may we point out that the first volume of "Vetinfile" does not constitute the whole. "Vetinfile" is not published as a complete work with small quarterly addenda; it is a quarterly publication, the supplements to which in twelve months double the initial issue. As volumes are completed new covers are provided gratis to subscribers. "Vetinfile" does indeed "provide information in a concise and acceptable form" but in addition subscribers themselves may decide whether the nature and quality of the abstracts are what they are looking for and this they can encourage simply by writing to our editors. All subscribers' requests are promptly dealt with.

We entirely agree that there is a place in veterinary literature for a new publication furnishing an additional information service. Once again we must thank our reviewer for realising the importance of what we are trying to achieve.

Since the issue of review copies our brochure has been circulated clearly stating the names of publisher, editor-in-chief and full details of "Vetinfile." Whatever its effect on Britain, the response to "Vetinfile" from overseas subscribers has been most stimulating.

Yours faithfully
C. A. DEVEREAUX.
Manager, Sales and Distribution.
Nivek Publications Limited.
August 15th, 1958

A Scale of Veterinary Fees

Sir,—Having retired from active practice due to old age and ill temper, I still, to keep up to date, read the letters in THE VETERINARY RECORD.

I have read that from Mr. Harrison of Matlock, and feel that the scale of fees he would appear to recommend is admirable, if slightly low.

I am prepared, even at my advanced age and lack of modern training, to return to practice to castrate tom cats at £2 per time as fast as they can be wheeled up. I would prefer to be paid on the maximum scale for standard procedure, and my practice, if any, would be related to that of the highest scale.

Bretton Hall, Yours faithfully,
Chester. COLIN JONES
August 12th, 1958

R.C.V.S. Council Elections

Sir,—I wish to congratulate Mr. J. F. D. Tutt on his election to the R.C.V.S. council, and to say that I agree fully with the opinions expressed in his letter dated June 16th, in reply to certain questions raised in my letter dated May 10th.

However, there is one point in my letter which I should like to amplify somewhat, namely the question of animal disease control in general, and of hog cholera in particular. In the past, the agricultural industry has very commendably supported our efforts in controlling the ravages of foot-and-mouth disease, and has, in the main, opposed any change in the slaughter policy.

I am of the opinion that vigorous leadership by the veterinary profession (which in recent years has been sadly lacking) would induce farmers to support (and demand!) an effective programme for controlling and eventually eradicating hog cholera in Great Britain. If the opinions expressed in his letter are any criterion, Mr. J. F. D. Tutt is the leader whom the profession has been seeking for a long time. Furthermore, in these days of television, radio, and nation-wide newspaper coverage, it should not be difficult to publicise the facts regarding the meat inspection situation, importation of foot-and-mouth disease, hog cholera, etc. All the profession needs is a public relations officer to organise such a publicity campaign. Public pressure upon the government will do the rest.

Unfortunately, however, much apathy exists in the profession with regard to these questions. This is clearly indicated by the fact that in the recent R.C.V.S council elections Mr. Tutt was the only elected candidate who was sufficiently concerned with the future welfare of the profession to answer the questions raised in my letter of May 10th. Do the other elected candidates have no opinions of their own, or are they not sufficiently interested in the welfare of their profession to make any comment at all on questions of vital importance to it? They owe it to the electors who gave them office to state clearly what they stand for.

Another indication of apathy in respect of these matters is the almost complete absence of comment thereon in your columns; with the exception of the extremely commendable letter written by Mr. D. G. Earnshaw in the "Record" dated July 19th, 1958. This situation contrasts very strangely indeed with the tremendous volume of correspondence regarding the somewhat abstract, abstruse, and absurd subject of "Do Animals have Souls?" which appeared in your columns not so very long ago.

I urge all those gentlemen who were so voluble upon this fantastic subject to express their opinions on the much more vital issues which have been mentioned in this correspondence.

Yours faithfully,
J. N. SIMPSON-WHITE

9629 San Luis Avenue,
South Gate,
California, U.S.A.
August 23rd, 1958.

[With regard to public relations, Council recently approved the creation of the post of Professional Secretary to the B.V.A. Part of the duties attaching to this appointment, as soon as it is made, will be public relations.—*Editor*.

Diagnosis in Veterinary Medicine

Sir,—The speed of everyday life in its relation to veterinary practice encourages the establishment of a rapid diagnosis. This attitude is supported by the availability of many valuable drugs to-day, in particular the sulphonamides and antibiotics whose effects are generally quite comprehensive and can be expected, in many cases, to have beneficial results. This is unfortunately leading one away from the all-important need to retain and develop one's clinical ability, and to interpret symptoms and signs in terms of disease, so enabling a decision to be made more accurately as to the appropriate drug to be used.

There is, perhaps, an unfortunate trend, because of the speed of life, to overlook the importance of environment, feeding and management—in other words to stray from the field of preventive medicine, the true field for the operation of veterinary talent to-day. It does, undoubtedly, necessitate a knowledge of agricultural activities in so far as they bear upon animal health.

In order to help the practitioner in his work, the part played by the diagnostic laboratories becomes increasingly important. In this respect the presentation of morbid material and the accompanying history leave a lot to be desired. One has only to work in a laboratory to realise this fully.

Not only is it desirable to have the backing of a diagnostic laboratory service, preferably composed of veterinarians, but to carry this a stage further it would seem that a case can be made for specialists in various fields of animal disease. Take for instance the subject of scouring in pigs. What a variety of causes there may be, and who can say whether an antibiotic resistant organism, certain enteric coliforms, vibrios, or viruses are the underlying causes?

In a certain medical publication (*Med. Clin. N. Amer.* 41: 1931-1406, 1957), the following extract will serve to illustrate the degree to which our medical colleagues strive to form a satisfactory diagnosis:—

"Information necessary to establish the diagnosis of a virus disease is derived from:—

1. Clinical observations.
2. Epidemiological findings.
3. Isolation of virus.
4. Serological and immunological studies.
5. Anatomical investigations (histo-pathology)."

Yours faithfully,
Endfield, Woodhouse, J. D. P. O'BRIEN.
Sheffield.
August 25th, 1958.